INDOOR AIR QUALITY ASSESSMENT

Bridgewater Raynham Regional High School
Guidance Suite
415 Center Street
Bridgewater, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health
Indoor Air Quality Program
October 2017

BACKGROUND

Building:	Bridgewater Raynham Regional High School (BRRHS), Guidance suite
Address:	415 Center Street, Bridgewater, MA
Assessment Requested by:	Paul Fox Jr., Facilities Director, Bridgewater Raynham Public Schools
Reason for Request:	Respiratory symptoms and general indoor air quality (IAQ) concerns, with a focus on airborne particulates and water damage
Date of Assessment:	October 11 and 13, 2017
Massachusetts Department of Public Health/Bureau of Environmental Health (MDPH/BEH) Staff Conducting Assessment:	Cory Holmes, Environmental Analyst/Inspector IAQ Program
Date of Building Construction:	2007
Building Description:	Two story concrete building housing offices attached to a garage/work area
Building Population:	Between five and ten employees in the Guidance Suite
Windows:	Some openable

METHODS

Please refer to the IAQ Manual and appendices for methods, sampling procedures, and interpretation of results (MDPH, 2015).

RESULTS and DISCUSSION

The following is a summary of indoor air testing results (Table 1).

- ***Carbon dioxide*** levels were above the MDPH recommended level of 800 parts per million (ppm) in areas surveyed, which indicates a lack of air exchange at the time of assessment. It is likely that fresh air intake was limited by the air conditioning (AC) system due to an unseasonably warm/humid stretch of weather over the previous week.
- ***Temperature*** was within the MDPH recommended range of 70°F to 78°F in areas tested.
- ***Relative humidity*** was within the MDPH recommended range of 40 to 60% in all areas tested.

- ***Carbon monoxide*** levels were non-detectable (ND) in all areas tested.
- ***Particulate matter (PM2.5)*** concentrations measured were below the National Ambient Air Quality (NAAQS) level of 35 μg/m^3 in all areas tested.

Particulate Matter

Building occupants expressed concern regarding airborne particles. As indicated by the air sampling for PM2.5, air measurements were below levels of concern established by the US EPA. Indoor air quality can be negatively influenced by the presence of respiratory irritants, such as airborne particulates. Exposure to carbon monoxide and particulate matter with a diameter of 2.5 micrometers (μm) or less (PM2.5) can produce immediate, acute health effects upon exposure. To determine whether measurable levels of these products were present in the indoor environment, BEH/IAQ staff obtained measurements for carbon monoxide and PM2.5. As stated above, no measurable levels of carbon monoxide were detected.

The US EPA has established NAAQS limits for exposure to particulate matter. Particulate matter includes airborne solids that can be irritating to the eyes, nose and throat. The NAAQS originally established exposure limits to PM with a diameter of 10 μm or less (PM10). In 1997, US EPA established a more protective standard for fine airborne particulate matter with a diameter of 2.5 μm or less (PM2.5). This more stringent PM2.5 standard requires outdoor air particle levels be maintained below 35 μg/m^3 over a 24-hour average (US EPA, 2006). Although both the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) standard and Building Officials and Code Administrators International, Inc. (BOCA, 1993) adopted the PM10 standard for evaluating air quality, MDPH uses the more protective PM2.5 standard for evaluating airborne PM concentrations in the indoor environment.

Outdoor PM2.5 concentrations the day of assessment were measured at 12 μg/m^3 (Table 1). PM2.5 levels measured in the Guidance suite ranged from 4 to 6 μg/m^3 (Table 1), which were below the NAAQS PM2.5 level of 35 μg/m^3. Frequently, indoor air levels of particulates (including PM2.5) can be at higher levels than those measured outdoors. A number of activities that occur indoors and/or mechanical devices can generate particulate matter during normal operations. Sources of indoor airborne particulates may include but are not limited to particles generated during the operation of fan belts in the HVAC system, use of stoves and/or microwave

ovens in kitchen areas; use of photocopiers, fax machines and computer printing devices; operation of an ordinary vacuum cleaner and heavy foot traffic indoors.

Ventilation

The heating, ventilation and air conditioning (HVAC) system consists of rooftop handling units (AHUs) controlled by a computerized program. The units supply conditioned air to occupied spaces via ductwork to local variable air volume (VAV) boxes above the ceiling of the Guidance suite (Picture 1). Conditioned air is delivered to spaces via wall or ceiling vents (Picture 2). Air is drawn into the above ceiling plenum through grates (Picture 3) and returned back to the rooftop units via ductwork. The system also provides AC. At the time of assessment airflow in office A143 appeared to be weak/minimal.

It was also reported that maintenance staff had removed/discarded VAV filters prior to the MDPH assessment (Picture 4), therefore they could not be evaluated. BEH/IAQ staff returned to the Guidance suite two days later on October 13, 2017 and found the VAV filters had been replaced (Picture 5). It should be noted that this type of VAV box filters provide minimal filtration. The rooftop AHU (Picture 6), where fresh air is drawn into the system, contains two rows of pleated high-efficiency filters (Pictures 7 and 8). The MDPH recommend that AHUs be outfitted with pleated filters of a Minimum Efficiency Reporting Value (MERV) of 8, which are adequate in filtering out pollen and mold spores (ASHRAE, 2012). In addition, filters should be changed 2-4 times a year or in accordance with the manufacture's recommendations. The AHUs at BRRHS are MERV 8 and are reportedly changed 3 times per year.

Microbial/Moisture Concerns

It was reported that over the summer a roof drain had clogged resulting in water infiltration into the Guidance suite and that school maintenance staff began drying/water extraction methods within 24 hours of detection. No current water damage and or visible mold growth was observed on building materials in the space or above ceiling tiles, with the exception of one stained tile (Picture 9).

Loose/hanging insulation material was noted around ductwork above the ceiling near the Guidance reception desk (Picture 10). Exposed metal/ductwork can be prone to condensation,

which can wet ceiling tiles and create conditions for mold growth. In addition, the exposed insulation can be a source of dust and debris.

Other Conditions

Other conditions that can affect IAQ were observed during the assessment. The Guidance suite is carpeted. BRRHS maintenance staff reported that the carpets were cleaned over the summer. Carpets should be cleaned annually (or semi-annually in soiled/high traffic areas) in accordance with Institute of Inspection, Cleaning and Restoration Certification (IICRC) recommendations, (IICRC, 2012). Regular cleaning with a high efficiency particulate air (HEPA) filtered vacuum in combination with an annual cleaning will help to reduce accumulation and potential aerosolization of materials from carpeting.

Several supply vents were observed to have accumulated dust/debris (Picture 2). Supply vents can aerosolize accumulated dust once activated or provide a source for mold growth under moist conditions if not cleaned.

Finally, exposure to low levels of total VOCs (TVOCs) may produce eye, nose, throat, and/or respiratory irritation in some sensitive individuals. To determine if VOCs were present, BEH/IAQ staff examined rooms for products containing VOCs. BEH/IAQ staff noted hand sanitizers, cleaners, air fresheners and dry erase materials in use within the building (Table 1). These products have the potential to be irritants to the eyes, nose, throat, and respiratory system of sensitive individuals.

CONCLUSIONS and RECOMMENDATIONS

In view of the findings at the time of the visit, the following recommendations are made:

1. Adjust the system to increase fresh air intake into the Guidance suite, particulary airflow into office A143.
2. Continue with plans to have the automated HVAC system evaluated for proper function. The MDPH recommends adopting a balancing schedule of every 5 years for all mechanical ventilation systems, as recommended by ventilation industrial standards (SMACNA, 1994).

3. Continue to change filters in HVAC units included VAV boxes a minimum of twice per year (e.g., between heating/cooling seasons) or as per the manufacturer's instructions. Upgrade filters in AHU to MERV 8 or higher.
4. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Avoid the use of feather dusters. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritation).
5. Replace water-damaged ceiling tiles after leaks are discovered and repaired.
6. Make repairs to loose/hanging insulation above ceiling near the Guidance reception desk (Picture 10) to prevent condensation and dust/debris.
7. Clean supply, return and exhaust vents periodically of accumulated dust.
8. Continue to clean carpeting annually or semi-annually in soiled high traffic areas as per the recommendations of the Institute of Inspection, Cleaning and Restoration Certification (IICRC, 2012).
9. Consider reducing the use of hand sanitizers, air deodorizers, and other scented materials in use within the office since these products have the potential to be irritants to the eyes, nose, throat, and respiratory system of sensitive individuals.
10. Refer to resource manual and other related indoor air quality documents located on the MDPH's website for further building-wide evaluations and advice on maintaining public buildings. These documents are available at http://mass.gov/dph/iaq.

REFERENCES

ASHRAE. 2012. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Standard 52.2-2012 -- Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size (ANSI Approved). 2012.

BOCA. 1993. The BOCA National Mechanical Code/1993. 8th ed. Building Officials and Code Administrators International, Inc., Country Club Hill, IL.

IICRC. 2012. Institute of Inspection, Cleaning and Restoration Certification. Carpet Cleaning: FAQ. Retrieved from http://www.iicrc.org/consumers/care/carpet-cleaning.

MDPH. 2015. Massachusetts Department of Public Health. Indoor Air Quality Manual: Chapters I-III. Available at: http://www.mass.gov/eohhs/gov/departments/dph/programs/environmental-health/exposure-topics/iaq/iaq-manual/.

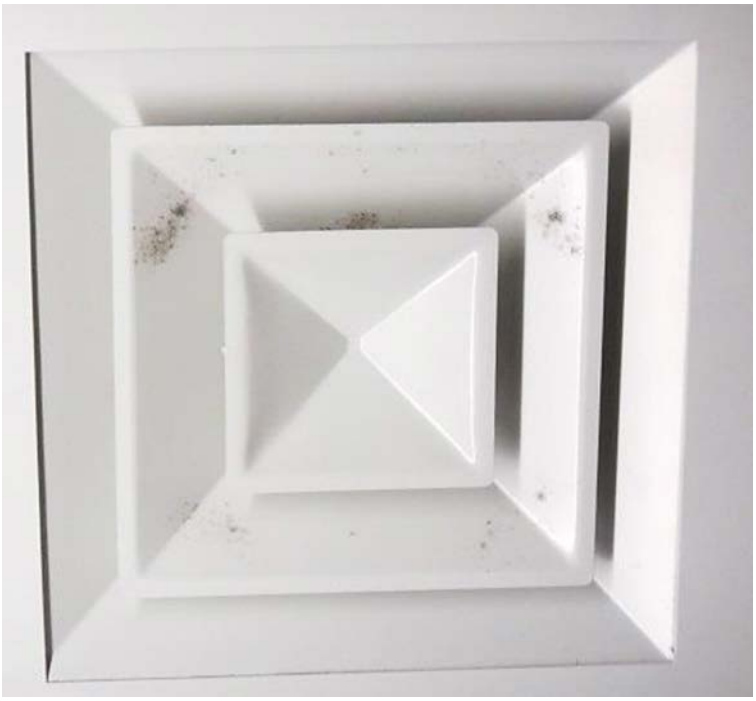
SMACNA. 1994. HVAC Systems Commissioning Manual. 1st ed. Sheet Metal and Air Conditioning Contractors' National Association, Inc., Chantilly, VA.

US EPA. 2006. National Ambient Air Quality Standards (NAAQS). US Environmental Protection Agency, Office of Air Quality Planning and Standards, Washington, DC. https://www.epa.gov/criteria-air-pollutants/naaqs-table.

Picture 1

VAV box above ceiling tiles in Guidance suite

Picture 2



Supply diffuser, note dust/debris accumulation on louvers

Picture 3

Ceiling-mounted return vent

Picture 4

VAV box with filter removed, note loose clips at top and bottom (arrows)

Picture 5

Mesh filter on VAV box in Guidance suite

Picture 6

Rooftop AHU for Guidance suite

Picture 7

Two rows of pleated filters in rooftop AHU

Picture 8

MERV 8 Filters in rooftop AHU

Picture 9

Stained ceiling tile

Picture 10

Loose/hanging insulation around ductwork above ceiling near Guidance reception desk

Location: Bridgewater Raynham Regional High School **Indoor Air Results**

Address: 415 Center Street, Bridgewater, MA **Table 1** **Date:10/11/2017**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m^3)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
Background (outdoors)	393	ND	69	61	12					Mostly sunny, scattered clouds
Guidance Suite Main Area	908	ND	72	57	6	3	Y	Y	Y	Door open
A143	1033	ND	70	60	4	1	N	Y	Y	Carpet squares, air deodorizer, dust/debris on vents, hand sanitizer, scented candle
A151	942	ND	70	60	6	0	N	Y	Y	Door open, dust/debris on vents, hand sanitizer

ppm = parts per million ND = non detect µg/m^3 = micrograms per cubic meter

Comfort Guidelines

Carbon Dioxide:	< 800 ppm = preferable	Temperature:	70 - 78 °F
	> 800 ppm = indicative of ventilation problems	Relative Humidity:	40 - 60%